USDA NRCS
Natural Resources Conservation Service

Constructed Wetlands for Animal Waste Treatment

Alabama Guide Sheet No. AL 656

Definition

A constructed wetland is a shallow surface-flow treatment system that uses aquatic vegetation to facilitate the reduction of pollutants in liquid animal wastes.

General Information

Research has shown that constructed wetlands will remove large amounts of nutrients, organic matter, suspended sediment, and bacteria from animal wastewater when properly sized, constructed, and maintained. However, the Alabama Department of Environmental Management (ADEM) has a "no discharge" policy for animal waste systems. Therefore, treated wastewater leaving the constructed wetland must be collected and land applied, recycled into a lagoon or waste storage pond, or used as flush water.

Constructed wetlands built in sandy locations will need compacted clay or other type liners beneath the root zone of the plants.

Benefits from Constructed Wetlands

- Significantly reduces contaminants (nutrients, organic matter, suspended solids, etc.).
- Requires less land area for disposing of wastewater produced at the facility resulting in:
  - less labor and maintenance for the irrigation system, and
  - larger buffer areas between the irrigation site and public areas or neighbors.
- Greatly reduces the volume of wastewater in summer due to high evapotranspiration losses.
- Reduces odor problems.
- Provides wildlife habitat.
- Provides an aesthetically pleasing element in the landscape, especially if planted with ornamental plants.
- Ensures high treatment efficiency even in winter.

Problems with Constructed Wetlands

- Solids will build up at a slow rate (i.e., ½ in/yr); therefore, renovation of the wetland may be required in 10-15 years.
- The rate of phosphorus removal may decline with time, especially if soils in the wetland have a low clay content.
- Treatment levels are not always consistent depending on dormancy of plants, temperatures, rainfall, etc.
- Pre-treatment or dilution of wastewater is required. Strong wastewater may kill plants.
- Water leaving the wetland cannot be discharged.
- In summer months with high evapotranspiration rates, additional water may be required to maintain plants.

Method of Operation

Plant litter that forms on the bed of the wetland becomes substrate on which countless millions of bacteria and fungi grow. This microbial community provides the bulk of the treatment versus plant uptake. For this reason, it is essential that the wastewater in the wetland always be deep enough to completely cover the litter.

Water level in each cell is controlled by a specially designed piping system downstream of the cell. Using this system, the operator can completely drain the cells for maintenance, if needed.

Size of Constructed Wetlands

The size of the wetland is based on the number of animals, the level of nutrient reduction in the pre-treatment unit, and the level of nutrient reduction needed to match the crop requirements at the final application site. Typical wetland size ranges from 0.5 to 3.0 acres.

Layout and Operation

The overall length to width ratio for the wetland is usually 4:1, although other ratios can be used to fit the lay of the land. It is desirable to have at least two wetland cells parallel, allowing one to be closed for maintenance while the other remains open. In the lengthwise direction, two or more cells may be required based on the topography. Slope in the lengthwise direction must be less than 0.5 percent. The slope of all cells must be zero from side to side.

Establishing Constructed Wetlands

Constructed wetlands should be planted with emergent vegetation. Proper selection of plant species for the different wetland cells is important for the success of the system (see “Guidelines for Establishing Aquatic Plants in Constructed Wetlands”).

Wetland plants can be collected from the wild or purchased from commercial nurseries. If there is a delay between collection and planting, plants should be frequently watered and provided with shade. Install plants as soon as possible after collection. Wetlands are generally planted with whole plants or dormant rhizomes and tubers. Taller varieties should be cut to a height of about 18 inches. The best transplanting window for Alabama is from early April to mid June.

The bottom of the wetland cells should be disked, harrowed, and otherwise prepared for planting root stock or seedlings. It may be necessary to release some water onto a site to provide adequate soil moisture prior to planting.

Modified tree planters can be used for bareroot wetland species. Hand planting with dibbles is also an option.

In the southeast, a 3- to 4-foot spacing for most herbaceous plants provides a good stand in about four to six weeks, and excellent coverage in eight to ten weeks. Giant Cutgrass should be planted on 6- to 8-foot centers.

Proper water level and its careful regulation are the most critical factors for plant survival during the first year. Flooding can cause more problems for wetland plants during the first growing season than too little water. After planting, the bottom of the cells should be saturated with pond water (not wastewater) to about 1-inch depth for four to five weeks, or when the submergent plants show new and vigorous growth. The water level should then be slowly and gradually increased to support erect and upright growth forms. The plants should become well established before wastewater effluent is discharged into the constructed wetland.

Maintenance of Constructed Wetlands

The maximum and average operating depths vary according to the plant species in the wetland. Some species can tolerate up to 12 inches of depth while others tolerate much less. Usually the most dense and diverse growth of plants occurs when the water depth is between 0 and 6 inches. However, effective treatment depends on the soil and bottom litter being completely covered at all times.

Reinforcement plants may need to be added to areas that experience predation or have poor survival after one or two growing seasons.

Muskrats and other burrowing animals can damage dikes and spillways. These animals should be controlled. Wire mesh has also been added in the construction of the dikes to deter the burrowing of these animals.

Livestock grazing can cause serious damage to the wetland vegetation. Perimeter fencing may be

required if livestock are anticipated to be a problem.

Vegetative cover on dikes and spillways should be maintained by mowing and fertilizing as needed. Shrubs and trees should be removed from the wetland cells, dikes, and spillways.

References

Constructed Wetlands and Wastewater Management for Confined Animal Feeding Operations, Gulf of Mexico Program.

Guidelines for Establishing Aquatic Plants in Constructed Wetlands, NRCS and Fort Valley State University Cooperative Extension Program, Fort Valley, Georgia.

Constructed Wetlands for Animal Waste Treatment, A Manual on Performance, Design, and Operation with Case Histories, USEPA Gulf of Mexico Program.